IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

In re Application of.:		§		
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	Velger et at	§		
		§	Confirmation No.	5153
Serial No.:	10/554,002	§		
		§		
Filed:	August 18, 2006	§	Group Art Unit:	2873
		§		
For:	OSCILLATING MIRROR HAVING A PLURALITY OF EIGENMODES	§ § §		
		§	Attorney Docket:	**51381**
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Examiner:	TRA, TUYEN Q	§		

Mail Amendment
Commissioner for Patents
P.O. Box 1450
Alexandria, VA 22313-1450

DECLARATION OF PROFESSOR IZHAK BUCHER UNDER 37 CFR 1.132

I am a co-inventor in the above-identified application, and hold an appointment as Professor of Mechanical Engineering at the Israel Institute of Technology. I am currently the head of the Mechatronics Laboratory at the Israel Institute of Technology.

My academic qualifications and scientific achievements can be found in the attached Curriculum Vitae. I am considered an expert in mechanical engineering in the discipline of vibration.

I have studied the USPTO Official Action dated December 6, 2010 issued in the above-identified application. In the Official Action, the Examiner cites U.S. Patent No. 4,001,658 to Frenk. I have carefully studied Frenk's disclosure and found that the authors of this disclosure have made many scientific errors which I explain in my Declaration.

My first observation is with respect to the statements made in column 2 lines 31-43, which recite (emphasis added):

> Referring now to the drawings, in FIG. 1 there is represented a system with four intercalated mechanical

> oscillators, springs 15 of which are so coordinated with masses to be moved that their respective natural resonant frequencies correspond as nearly as possible to the desired overtones of the system. The mechanical oscillators are controlled individually by respective drive means 16, as for instance electromagnetic means as disclosed in U.S. Pat. No. 3,076,153 or a permanent magnet as disclosed in U.S. Pat. No. 3,525,887, or any other means of this art well known as piezoelectrically or hydraulically excited vibrators.

As an expert in mechanical engineering I declare that it is impossible to control the individual frequencies of intercalated oscillators where each one has a respective natural resonant frequency. A resonant frequency is a property of the entire system and must take into account all the masses and springs. To this end, see, for example, Ref. [1].

My second observation is with respect to the procedure formulated in column 3 lines 19-49, which recite (emphasis added):

> 1. determination of the moment of inertia of component 17.
> 2. converting the moment of inertia into the equivalent means m_n at the point of action of the last spring **15** (for instance at the end of the lever arm opposite that end supporting component **17**).
> 3. determining the spring constant D_n of this last spring by the formula
>
> $D_n = 4m_n\pi^2f^2_n$
>
> wherein f_n is the *n*th harmonic of the non-sinusoidal oscillation.
>
> Then the total mass m_{n-1} of the structure oscillating in the *n*th harmonic is formed. To this is added the mass m_n of component **17**, the mass of spring **15** and the

> mass of the last component **16**. This last one is adjusted as closely as possible to the natural frequency of the next lower harmonic f_{n-1}, D_{n-1} being computed by the formula of (3). This process is repeated until all the springs **15** have been determined.
> Obviously the computed spring constants D_1 . . . D_n and also the masses m_1 . . . m_n are designed within a given tolerance for accuracy.
> The larger the deviations of the individual natural frequencies from the exact values of the harmonics, the larger the powers required to force the accurate oscillations.
> <u>However, no rigorous constraints are required for the functioning</u>.

As an expert I declare that the above procedure cannot create a system with natural frequencies that are harmonic of each other. Any mathematical procedure for selecting the parameters of the system, such as the masses and spring constants, must follow mathematical constraints which are dictated by the equations of motion (see Ref. [2], for further details). However, the procedure described by Frenk in the above passage disregards the basic mathematical and physical constraints of a discrete vibrating system, particularly the constraints which tie together <u>all</u> the masses and springs in the system, and which prevent those masses and springs from being computed individually. Thus, by following such a procedure, no operative system can be designed, as the described iterative process fails to follow the mathematical constraints from step 1.

Moreover, the underlined part in the above passage is scientifically incorrect. In this respect, I refer again to Ref. [2] which explicitly shows that the masses and springs of a vibrating structure are tied together in constraint equations linking the values of one element (*e.g.*, spring) to the desired resonant frequencies and mass elements. Thus, it is incorrect that no rigorous constraints are required.

Thus, Frenk's procedure cannot lead to a system that provides non-sinusoidal vibration, in the sense that the natural resonances are integral multiples of each other.

In contrast to Frenk, my invention takes into account all the necessary equations and constraints such that the resulting system is fully operative, as claimed. I emphasize that numerous prototypes of the claimed system have been tested in the laboratory where their ability to provide non-sinusoidal waveform was demonstrated. Moreover, the theoretical considerations that underline my claims have been accepted by the scientific community and have been published in a peer review journal (see Ref. [3]).

REFERENCES

[1] Daniel J. Inman, "Vibration with Control," 2006, John Wiley & Sons Ltd., ISBN 9780470010518, Chapter 3 (pages 57-98)

[2] Gladwell, G.M, "Inverse Problems in Vibration," 2004, Springer, ISBN 9781402026706, pages 63-92.

[3] I. Bucher, "A Mechanical Fourier series Generator: An Exact Solution," 2009, Journal of Vibration and Acoustics, Transactions of the ASME, Volume 131, Issue 3, paper no. 031012.

I hereby declare that all statements made herein of my own knowledge are true and that all statements made on information and belief are believed to be true; and further that these statements were made with the knowledge that willful false statements and the like so made are punishable by fine or imprisonment, or both, under Section 1001 of Title 18 of the United states Code and that such willful false statements may jeopardize the validity of the application or any patent issued thereon.

Izhak

Prof. Izhak BUCHER

Date June 6, 2011